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Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:  
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Pickup unit comprising a stroke limiter, and a disk drive unit provided with such pickup unit

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Pickup unit comprising a stroke limiter, and disk drive unit provided with such pickup unit

## FIELD OF THE INVENTION

The invention relates to a pickup unit for reading and/or writing data on a disk, comprising a stroke limiter limiting the stroke of movements of the movable part in the pickup unit.

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## BACKGROUND OF THE INVENTION

One of the problems of such pickup units is that the stroke of the movable part in the pickup unit is so big that this movable part may hit adjacent parts of the pickup unit or the disk, which may damage the disk or optical or mechanical components of the pickup unit.

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A pickup unit in which it is attempted to solve this problem is known from EP-A 1 124 223. In this pickup unit the movable part is placed on the base such that the stroke of movement of the movable part in the tracking direction is limited by two standing wall portions provided on the base so as to surround the movable part. The range of movement of the movable part in the focusing direction is restricted by a stopper member.

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Thus, this pickup unit provides a mechanical system for limiting the stroke.

Alternatively, there are known pickup units in which the problem of an excessive stroke of the movable part is attempted to be solved by using signals from the optics and electronics of the pickup unit to sense an excessive stroke and provide a signal to the actuator in order to effect a counter force on the movable part so as to bring it back to a central position.

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It is an object of the present invention to provide a pickup unit having a simple and effective stroke limiter.

## SUMMARY OF THE INVENTION

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In order to accomplish that objective, the pickup unit according to the invention comprises a movable part which is connected to a base of the pickup unit by at least one elastic support member, the movable part being movable with respect to the base in a focussing direction of the movable part by bending the at least one elastic support member under the action of an actuator acting between the movable part and the base, further

comprising a stroke limiter between the base and the movable part to limit the stroke of the movable part relative to the base at least in the focussing direction, said stroke limiter comprising an electrical contact operatively connected to the actuator to cause the actuator to move the movable part towards a central position upon closure of the contact.

5 In the pickup unit according to the invention, the stroke limiter comprises an electrical contact which is operatively connected to the actuator to cause the actuator to move the movable part towards a central position upon closure of the contact. The advantage of this arrangement is that this stroke limiter enables a fast operation of the pickup unit as the movable part is quickly brought back to within its normal range of movement by the actuator.  
10 As a result, the operation of the pickup unit is continued quickly thereby preventing disturbance of the operation of the disk drive. However, the pickup unit according to the invention is not dependent on the optical system of the disk drive or on the presence of a disk with which the optical system cooperates.

Although the invention can be useful to limit the movement of the movable  
15 part in one direction, the embodiment of claim 2 is preferred since it minimizes the risk of damage to the pickup unit and disk.

A preferred embodiment of the pickup unit according to the invention is defined in claim 3.

According to this embodiment, a mechanical and electrical stop is combined,  
20 so that the movable part of the pickup unit may both be mechanically stopped and be brought back to its operational range. Preferably, the mechanical stop is combined with the electrical contact to simplify the structure of the stroke limiter.

A simple embodiment of the stroke limiter according to the invention is defined in claim 4, while it is preferred to combine it with the feature of claim 5, so that the  
25 electrical and mechanical contact are effected by the counter member.

If the feature of claim 6 is used in the pickup unit, the stroke limiter will be adjustable so as to precisely adjust the stroke limiter to the particular pickup unit. In this way, tolerances may be compensated for.

A very simple embodiment is defined in claim 7. In this embodiment, an  
30 existing member of a pickup unit is used as one of the parts of the stroke limiter, so that only an additional counter member is necessary.

In this embodiment it is favourable to use the feature of claim 5, since it ensures  
that the existing member and the added support member are electrically conducting with each other

The stroke limiter according to the invention may be integrated in existing pickup unit designs without many adaptations. In new designs, it may be preferable to use the feature of claim 12 as this will bring the point of contact closer to the centre of mass of the movable part of the pickup unit. This leads to a more favourable absorption of forces when  
5 the stroke limiter becomes active. This will improve the [] of the stroke limiter. The same is true for the embodiment of claim 14.

The invention also relates to a disk drive unit comprising the pickup unit according to the invention.

10 These and other aspects and advantages of the invention will be apparent from the following description with reference to the drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a simplified perspective view of a preferred embodiment of a pickup unit for a disk drive unit according to the invention;

15 Fig. 2 is a perspective view of the pickup unit of Fig. 1, as seen from the other side.

Fig. 3 is an enlarged view of detail III in Fig. 1.

Fig. 4 is a view corresponding to that of Fig. 3, but showing an alternative embodiment of the pickup unit according to the invention.

20 Fig. 5 is a smaller scale sketch of a disk drive including the pickup unit according to the invention.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

The drawings show a preferred embodiment of a pickup unit 1 according to  
25 the invention. This pickup unit may be used in a device for reading and/or writing data on a disk, such as a compact disk player, which is adapted to read/and or write disks for audio, video and/or data by means of an optical, magnetic or the like reading and/or writing member.

Fig. 5 shows such a disk drive unit including a motor 20 and spindle 21, as  
30 well as an optical system 22 including the pickup unit 1 to read/write the data from/onto a disk D. In Fig. 5, the disk D is shown as being accommodated in an optional cartridge C which is inserted into the drive unit. The disk D has its clamping area engaged by the spindle 21 of the motor 20 in order to be driven. The lens of the pickup unit 1 is positioned very closely to the disk 1 when inserted.

In an (optical) disk for use in the previously described disk drive unit, data is encoded in one or more layers of the disk. Various principles are known, each variant being suitable for use in conjunction with the invention. The data is laid down in one or more data tracks in digital form. The variations of (optical) properties along the data tracks contains the data recorded on the disk. To read and/or write the data on the disk, it is rotated by means of a disk drive motor. The disk is read and/or written by detection of the variations of (optical) properties along the data tracks by the pickup unit. In the presently preferred embodiment according to the invention the variations are detected by means of laser light emitted from and reflected back to the pickup unit.

With reference to Figs. 1 - 4, the preferred embodiments of the pickup unit 1 comprise a lens (to be mounted in hole 2) as reading and/or writing member mounted to a movable part, in this case a lens holder 3. The lens holder 3 is connected to a base 4 of the pickup unit 1 by means of four rectilinear wire members 5 which are made of a resilient, preferably electrically conductive material, such as copper, iron or an alloy. In this manner, the wire members 5 form elastic support members for suspending the lens holder 3 in a steady (pre-biased) position when no external force is exerted on the lens holder 3, and allowing the lens holder 3 to be slightly moved with respect to the base 4 when a force is applied to the lens holder 3.

The pickup unit 1 as a whole is movable in a tracking direction  $y$  with respect to the disk by means of a sledge mechanism (not shown). Under the action of an actuator 6, 7, 8 (see Fig. 4, in Figs. 1 - 3 it is omitted) provided between the lens holder 3 and the base 4, the lens 2 of the pickup unit 1 is movable with respect to the disk and the base 4 in the tracking direction  $y$  and in a focussing direction  $z$ , and is tiltable about a tangential axis  $x$ . In the focussing direction the movable part is movable towards and away from the disk to be scanned.

In the preferred embodiment of the pickup unit 1, the actuator 6, 7, 8 comprises a plurality of permanent magnets 9 connected to the base 4 and a plurality of coils 10 connected to the lens holder 3 and positioned opposite the permanent magnets 9 respectively, wherein the coils 10 and the permanent magnets 9 exert forces to the lens holder 3 by means of electric currents through the coils 10. The movement of the lens holder 3 with respect to the base 4 and the disk is used to focus the laser light to the exact point on the data track in the disk and/or to move the lens holder 3 in such a way that the laser light is always locally perpendicular to the surface of the disk despite an inclination of the disk relative to the surface of the pickup unit 1.



To accurately control the position and orientation of the lens holder 3 of the preferred embodiment of the pickup unit 1, the electric currents through the coils 10 are provided by a control circuit (not shown). In order to determine the actual position of the lens holder 3 with respect to the disk, the control circuit may for example use intensity parameters of the laser light received by the pickup unit 1. The control unit is not considered part of the invention and a multitude of possible implementations of a control circuit for this purpose are known, so that no further description is given of the control unit.

The lens holder 3 carrying the lens 2 is adapted to be positioned at a very small operating distance with respect to the surface of the disk, typically 150  $\mu\text{m}$  to 1 mm, and is also positioned at close distance to the permanent magnets 9. A sudden large movement of or vibrations in the pickup unit may cause the lens holder 3 to strike against the disk or magnets which may lead to damage of the lens holder 3, lens 2 and/or disk.

According to the invention, there is provided a stroke limiter 11, in this case comprising a limiter plate 12 attached to the base 4 in a position close to the lens holder 3. The limiter plate extends substantially perpendicularly to the wire support members 5 which extend through holes 13 in the limiter plate 12. These holes 13 have such dimensions/diameter that there is a free space or play around the wire members 5 which determine the free movement of the wire members 5 at the position of the limiter plate 12 (see also Fig. 3). This determines the free stroke of the lens holder 3 in the various directions.

The dimensions of the holes 13 are selected such that the lens holder will not be able to hit the magnets 10 and will also be limited in the focussing direction to prevent or diminish the risk of hitting the disk. The limiter plate 12 or another stroke limiting member may be adjustable to compensate for tolerances between the lens holder 3 and the base 4. The holes 13 may be square, rectangular round or any other shape that would cause a desired limitation of the stroke of the lens holder in the required directions. The holes may surround the wire members completely or only partly. In fact, in the embodiment shown, the corner portions of limiter plate 12 may be removed thereby creating a notch or recess, such that the holes 13 may have only two sides adjacent the respective wire member 5. The various holes limit the movement of the respective wire members 5 in different directions so that the holes 13 complement each other and together limit the movement of the lens holder 3 in all directions.

The wire members 5 are conducting and this property is used to function as a contact for the stroke limiter. The counter member, in this case the limiter plate 12 is also at least partly electrically conducting and connected such that a contact between one or more of the wire members 5 with the limiter plate 12 will effect a reverse current or a restoring signal

such that the actuator 6, 7, 8 will be actuated to exert a return force on the lens holder 3 to move it back to its central position, or at least within its operating range. This will bring the lens holder quickly to within its operating "in focus" range so that, when the pickup unit is in operation, it can quickly regain its proper operation.

5 Fig. 4 shows an alternative embodiment in which the limiter plate comprises an additional hole 14 co-operating with a protruding pin 15 provided on the lens holder 3. These co-operating pin and hole act as stroke limiter at least in two directions, whereas the tilting movements are limited by the co-operation between the wire members 5 and holes 13. Preferably, the pin 15 extends substantially through the centre of mass of the lens holder 3 to  
10 limit moments of inertia on the lens holder when the movement of the lens holder is limited by the limiter plate 12. Ideally, the stroke limiter would have an effective point of engagement exactly in the centre of mass of the lens holder.

From the foregoing description it should be understood that the pickup unit 1 according to the invention provides a simple and effective stroke limiter for the pickup unit  
15 of a disk drive.

The invention is not restricted to the above-described embodiment as shown in the drawings, which can be varied in several ways without departing from the scope of the invention.

For example, the elastic support members may have any kind of shape  
20 between their mounting positions, and they may each have a different bending stiffness, as long as the centre of stiffness of the wire members coincides with the centre of mass of the lens holder. Accordingly the number of elastic support members is not limited to four, whereby the pickup unit may for example also be provided with six elastic support members arranged in two cooperating groups of support members instead of two cooperating pairs of  
25 support members.

As a further example, the mounting positions of the elastic support members of each cooperating pair at the lens holder and the base may be spaced apart over an equal distance and in the same direction in any direction to obtain the (dynamic) properties of the movement of the lens holder as stated before.

30 In another variation, the elastic support members may extend at a slight angle with respect to a virtual plane through the lens in the focussing direction and the tangential direction.

exclude additional elements or steps. Reference signs in the claims shall not be construed as limiting the scope thereof. A single processor or unit may fulfil the functions of several elements in the appended claims.

In the presently preferred embodiments, the disk is an optical data disk.

- 5 However, it should be understood that the invention can also be used for all kinds of other disks e.g. ferro-electric, magnetic, magneto-optic, near-field, active charge storage disks or other disks using combinations of these techniques or other reading and/or writing techniques. In these cases the lens will be replaced by another reading/writing member.

- 10 The invention is not limited to the embodiments shown in the drawing and described hereinbefore which may be varied in different manners within the scope of the appended claims. For example, the stroke limiter may comprise a protrusion mounted to the base and a counter member mounted to the lens holder. In all embodiments, the parts of the stroke limiter may be completely electrically conducting or comprise contacts and conductors to provoke a desired signal or current upon closure of the contact in the stroke limiter.

- 15 In case the elastic support members are attached to projecting parts of the movable part, they can be extended beyond the projecting parts through an extension. These extensions may co-operate with the counter member and thus function as a stroke limiter which is positioned closer to the centre of mass of the movable part of the pickup unit.



## CLAIMS:

1. Pickup unit (1) for reading and/or writing data on a disk, comprising a movable part (3) which is connected to a base (4) of the pickup unit (1) by at least one elastic support member (5), the movable part (3) being movable with respect to the base (4) in a focussing direction (z) of the movable part by bending the at least one elastic support member (5) under the action of an actuator (6, 7, 8) acting between the movable part and the base, further comprising a stroke limiter (11) between the base and the movable part to limit the stroke of the movable part relative to the base at least in the focussing direction, said stroke limiter comprising an electrical contact (5, 12, 13; 15, 12, 14) operatively connected to the actuator (6, 7, 8) to cause the actuator to move the movable part towards a central position upon closure of the contact.
2. Pickup unit according to claim 1, wherein the stroke limiter (11) is configured to limit the stroke of substantially all possible movements of the movable part (3).
3. Pickup unit according to claim 1 or 2, wherein the stroke limiter (11) is of an electro-mechanical type including, besides the electrical contact, a mechanical stop.
4. Pickup unit according to claim 3, wherein the mechanical stop includes at least a protruding member (5; 15) and a counter member (12) having a hole (13; 14) surrounding the protruding member at least partly with a play determining the stroke of the movable part.
5. Pickup unit according to claim 4, wherein the protruding member (5; 15) and the counter member (12) are electrically conducting to form the electrical contact.
6. Pickup unit according to claim 4 or 5, wherein at least one of the protruding member (5; 15) and counter member (12) is adjustable.

7. Pickup unit according to any one of claims 4 – 6, wherein the protruding member (5) is formed by the elastic support member engaging through the hole (14) near the movable part (3).
- 5 8. Pickup unit according to claim 7, wherein the at least one elastic support member (5) is made of an electrically conducting material, and serves as part of the electrical contact of the stroke limiter (11).
9. Pickup unit according to any one of the preceding claims, comprising a  
10 plurality of elastic support members (5), preferably four elastic support members.
10. Pickup unit according to claim 9, wherein the elastic support members (5) are wire members.
- 15 11. Pickup unit according to any one of claims 4 - 10, wherein the counter member (12) is a plate member mounted to the base (4) and co-operating with the protruding member (5; 15).
12. Pickup unit according to any one of claims 9 - 11, wherein the elastic support  
20 members (5) are attached to projecting parts of the movable part (3) and are extended beyond the projecting parts through an extension, said extensions co-operating with the counter member.
13. Pickup unit according to one of the preceding claims, wherein the protruding  
25 member (15) is a member separate from the at least one support member (5), and is preferably positioned such that it extends in a direction substantially through the centre of mass of the movable part (3).
14. Disk drive unit comprising the pickup unit according to any one of the  
30 preceding claims.

## ABSTRACT:

A pickup unit (1) for reading and/or writing data on a disk comprises a lens holder (3) which is connected to a base (4) of the pickup unit (1) by at least one elastic support member (5). the lens holder (3) is movable with respect to the base (4) by bending the at least one elastic support member (5) under the action of an actuator (6, 7, 8) acting  
5 between the lens holder and the base. A stroke limiter (11) is provided between the base and the lens holder to limit the stroke of the lens holder relative to the base. The stroke limiter (11) is of electro-mechanical type including, besides an electrical contact, a mechanical stop. The electrical contact (5, 12, 13; 15, 12, 14) is operatively connected to the actuator (6, 7, 8) to cause the actuator to move the lens holder towards a central position upon closure of the  
10 contact.

(Fig. 4)





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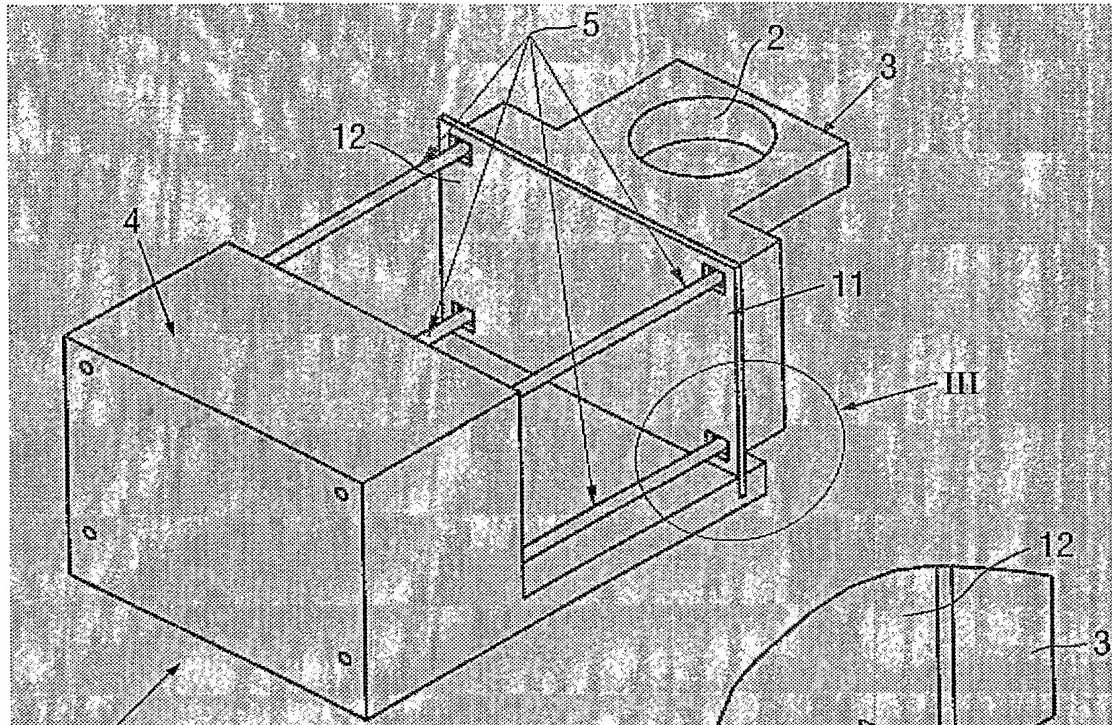


FIG. 1

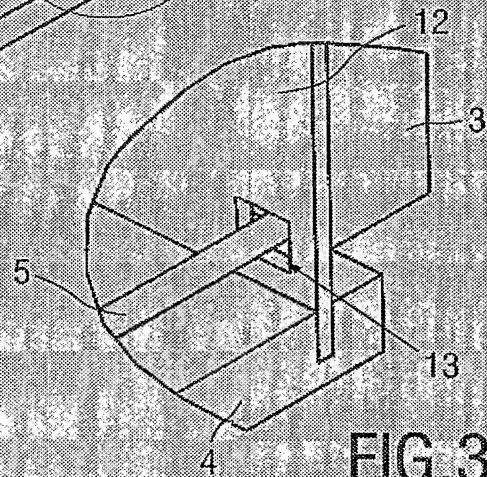


FIG. 3

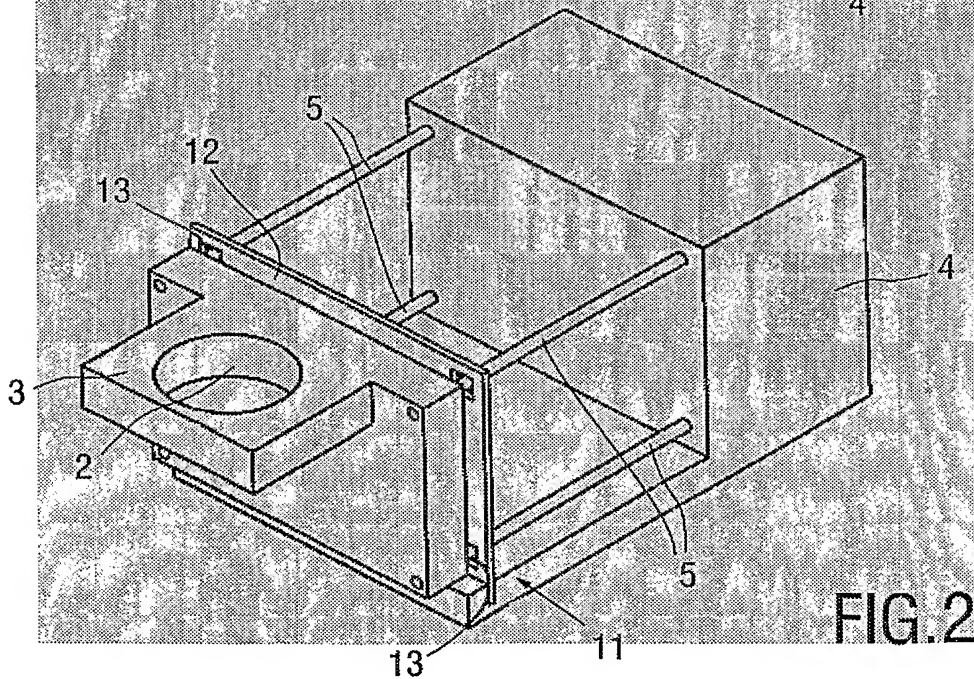
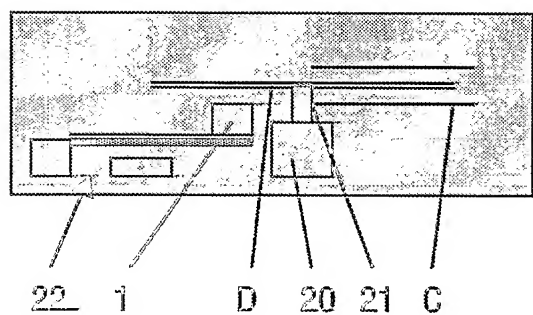
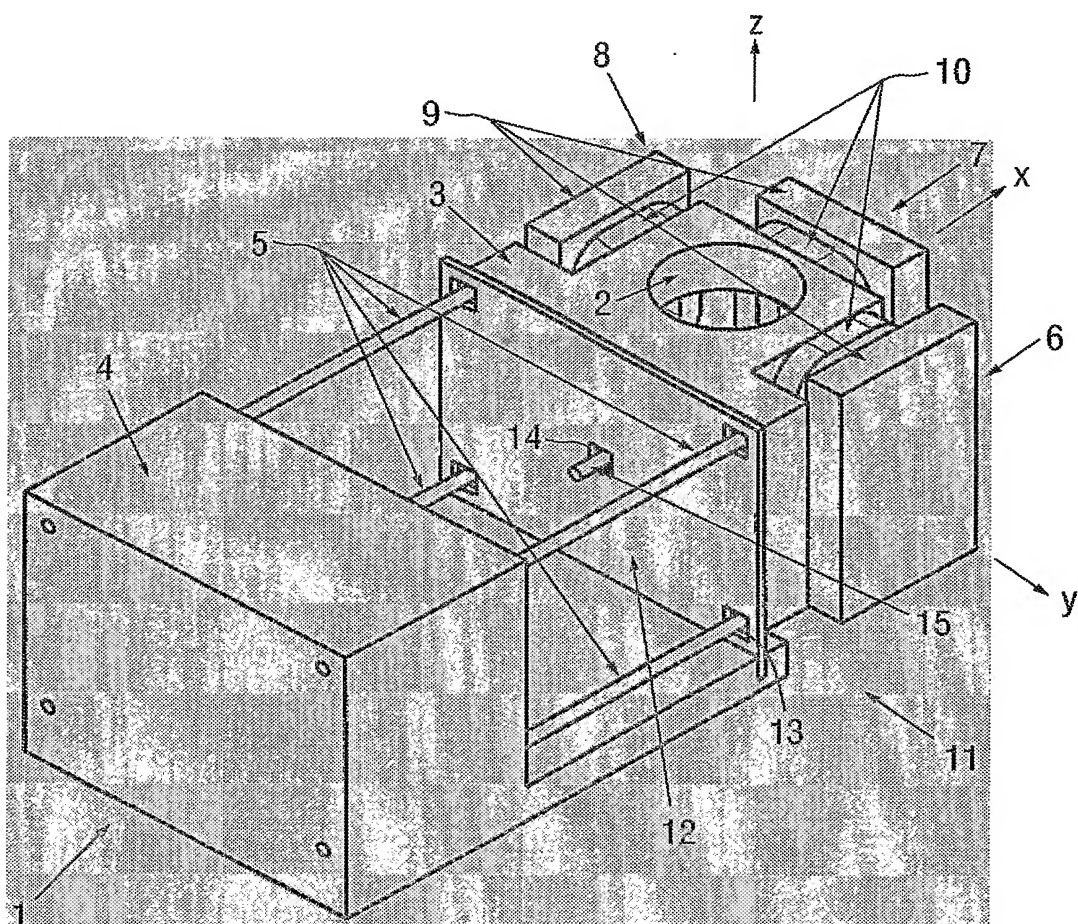


FIG. 2

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